Pages from the Past *50th Anniversary*

1965

February 21
Malcolm X is killed at a rally in Harlem.

March 8
First U.S. combat troops arrive in Vietnam.

March 18
Soviet cosmonaut Aleksei Leonov performs the first spacewalk.

March 25
Civil rights activists led by Martin Luther King Jr. begin march from Selma, AL, to Montgomery, AL.

June 3
Edward White II becomes the first American to walk in space.

Los Angeles Dodgers defeat Minnesota Twins in the World Series.

A first-class stamp costs $0.05.

Montreal Canadians defeat Chicago Blackhawks to win the Stanley Cup.

Management & Industrial Safety Achievement

A practical approach and new philosophy for risk evaluation and control

By John V. Grimaldi

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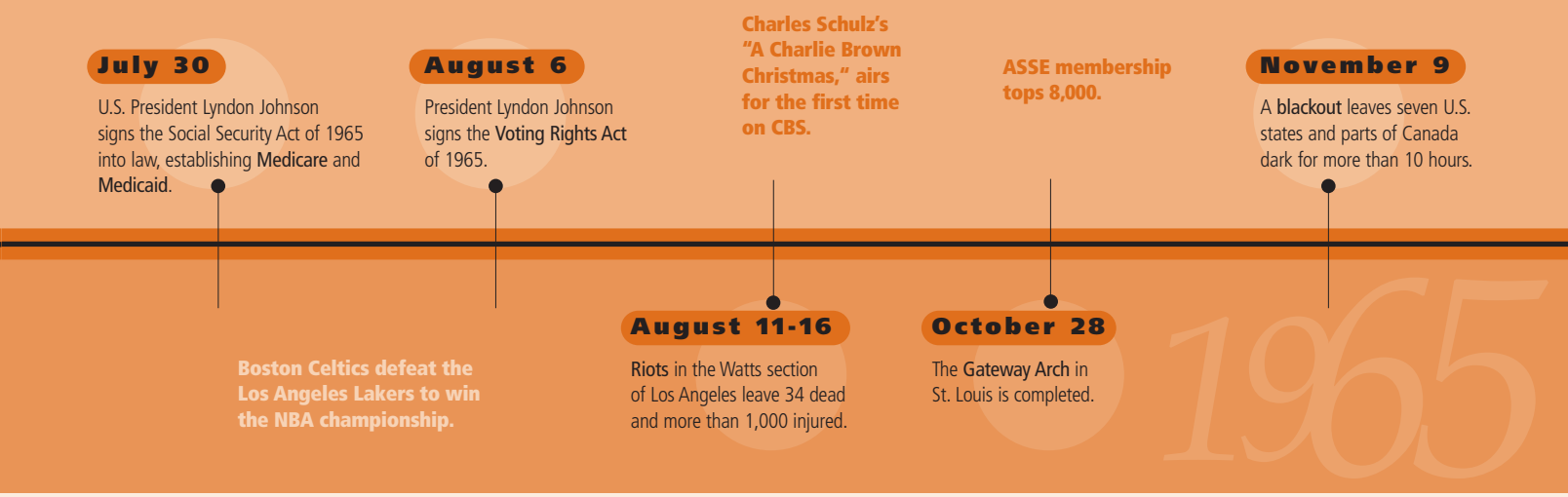
At the time this article was published, John V. Grimaldi, Ph.D., was a consultant for health, safety and plant protection, General Electric Co., New York. In his career, he served as executive director and professor of safety science and systems management at the Institute of Safety and Systems Management, University of Southern California; clinical professor of community and environmental medicine at the University of California, Irvine, College of Medicine; director of the Center for Safety, and chair of the Dept. of Safety Sciences and Education at New York University; director of the Engineering and Research Div. of the Association of Casualty and Surety Companies; research associate at the Center for Safety; and director of safety for Grumman Aircraft Engineering Corp. Grimaldi, the Society's 1961-62 President and an ASSE Fellow, coauthored Safety Management: Accident Cost and Control, *with Rollin Simonds. The book has been a leading college text for many years and is on the recommended book list for those pursuing the CSP designation. He also wrote several articles for the journal during his career. This article was based on his presentation at the Massachusetts Safety Conference held March 22, 1965, in Boston. It received the second-place award in the Society's Technical Paper Awards the following year. Grimaldi earned his B.S., M.S. and Ph.D. degrees from New York University; he also earned a chemical engineering degree from Polytechnic Institute of Brooklyn.*

INDUSTRIAL LEADERSHIP TODAY carries a greater responsibility than it did a few generations ago. Now, moral firmness and a regard for human values are added ingredients in the prescription for business progress. People are the principal consideration of business. Pleasing them is its ultimate purpose, but the fulfillment of these responsibilities often is complicated and confusing.

The difficulties are apt to be greatest when trying to implement a safety program. Attitudes toward safety are often perverse—a perplexing alternation between first, a wishful search for security and freedom from fear, and then, a deliberate disregard of the obvious precautions which can fulfill the wish. It is not unusual to find a man taking his safety for granted, until he is in immediate and severe danger. Then customarily he reacts vigorously, even desperately, to protect himself. Often he delays too long, however, and the accident happens.

When misfortune befalls him, he calls it accidental even though it may be the predictable result of his defying the established proper procedures. He



might learn from his experiences, but a mishap's influence on his attitude tends to diminish inversely with time. It may even boomerang and a more reckless defiance may result, making the puzzle exceedingly difficult to rationalize.

It is this paradoxical behavior which everyone who has had a concern for the safety of others has struggled with. It explains why a primary consideration in a program for safety achievement is the ways and means for motivating interest in safety, and there are probably as many devices and approaches for doing this as there are safety specialists in practice.

Those with a responsibility for leadership have contended with adverse behavior since the beginning of time. Their first attempts at control: applied rules. Punishments were prescribed for violations. The motivation to behave, then and now, is assumed to be strengthened by penalizing violators. However, experience has taught that the threat of discipline may not be a powerful deterrent if a misdeed has great appeal.

Soon, it was obvious to the rulemakers that sterner measures were needed if a uniform level of proper behavior was to be achieved. Their answer was to write more comprehensive regulations and impose progressively harsher penalties. Historically these measures have not proven satisfactory, however.

The control of accidents by regulation first received extensive development in England when the evils of the apprentice system, in the 18th century, awakened the need for moderating work hazards. Safety and health legislation initially was directed at the textile industry where large numbers of pauper children were employed in cotton and woolen mills for excessive hours under wretched conditions.

Probably because of the restrictive legislation with respect to children, many English employers began to hire women and it would seem from the record that the conditions for female employment were not much better than they had been for the children.

Shortly thereafter, laws were passed detailing provisions for the safety and health of women workers. Almost simultaneously a coal mining law was passed compelling punitive compensation for preventable injuries due to unguarded mining machinery. The progress of English safety and health regulations is revealing. As the increasingly restrictive legislation spread across English industry, at no time it seems were the employers moved generally to correct the offending conditions. Apparently they did no more than what the law required, preferring to wait for legislative direction. The inclination to tend immediate necessities, and defer less-pressing issues until they become demanding, is familiarly human and notable in this experience.

U.S. Follows English Pattern

The English employers were no more human in their procrastination, however, than their early American counterparts. In the U.S., as might have been expected, the first moves toward safety and health regulation in industry followed the English pattern, but a significant change soon occurred. Safety rules and guarding physical hazards were found to be insufficient measures for safety achievement. Intensive safety education programs were the next step and they were followed by good results.

After 30 years of accident reduction progress, however, the occupational safety programs in the U.S. appeared to lose their impetus. From the year 1940 to 1948, the disabling injury experience of the reporters to the National Safety Council did not vary notably year to year (NSC 28). But it picked up again shortly after safety specialists widely instituted supervisor safety training programs.

These concentrated courses intend to educate supervision to its safety responsibilities and teach the means for increasing safety achievement. With their timely entry on the scene, the occupational disabling injury rate once again steadily reduced in America.

The stepped-up educational activity and concurrent work injury reductions convinced safety specialists generally that employee safety education must be the key to successful accident prevention. Industry therefore re-intensifed its safety training

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The death total in 1965 was up about 2,000 over 1964.

PRINCIPAL CLASSES OF ACCIDENTS

	Deaths	Change from 1964	Disabling injuries
Motor Vehicle	**49,000**	**+3%**	**1,800,000**
Public nonwork	45,900		1,700,000
Work	2,800		100,000
Home	300		negligible
Work	**14,100**	**-1%**	**2,100,000**
Nonmotor vehicle	11,300		2,000,000
Motor vehicle	2,800		100,000
Home	**28,000**	**-2%**	**4,200,000**
Nonmotor vehicle	27,700		4,200,000
Motor vehicle	300		negligible
Public	**19,000**	**+6%**	**2,400,000**

National Safety Council *Accident Facts*, 1966 edition.

activities and alert observers wondered whether an imbalance were occurring in plant safety programs.

It appeared that the education phase might be overstressed and this might be violating the premise that effective safety programs should be composed of equal parts of safety's three Es: engineering, education and enforcement.

American Injury Rates Improve

While American industry consistently improved its work injury rates, safety specialists studied and discussed the reasons. One expert, a member of a British study group published his observations in the magazine of the British Iron and Steel Federation:

> If guards in themselves prevented accidents, we would be in a position to show the Americans a thing or two. One forms the impression, rightly or wrongly, that they are lagging far behind us in this field. If organized training in itself led to good safety records, we could act as their advisers. And whilst they can show us a few tricks in the protective clothing and equipment trade which we haven't yet picked up, they cannot tell us a great deal about the quantities in which it should be issued. In a good many cases, we are way ahead of them in this respect.
>
> How, then, do you answer the British safety officers' question: 'What have the Americans got which would explain their superior safety records?' The answer is that the Americans have the right attitude of mind to create good safety records (Barry).

This singular attitude merits some philosophical inquiry since it is basic to safety achievement. The question is, does training impart such wisdom? When it is recalled that the British expert reported his colleagues "could act as . . . advisers" to the Americans' training programs, doubt is cast on the likelihood that training in itself is responsible for any notable differences between the observed work injury rates.

However, there may be one distinguishing feature in American safety programs. They usually are intensive. The inescapable conclusion, therefore, is that it is the intensity of the U.S.'s training activity which generates the noted stronger safety motivation and the inducement probably is the easily recognizable implication that management wants its work done safely.

If one were to examine closely the safety motives of American workers, it is possible that in addition to a personal wish to avoid injury there is a distinct desire to work safely because the employer expects them to. This stimulation is subtle in many instances.

Employer safety activity in America largely is voluntary. Although the states and the federal government regulate certain hazardous exposures, the

implementation of safety requirements generally is left to the employer. He initiates and directs the activity according to his needs and judgment largely without governmental persuasion.

Therefore, while the programs teach safety principles they demonstrate management's voluntary interest in accident prevention. The effect doubtless is inestimable. The employer's action in inaugurating a safety function and staffing it, usually with qualified junior-type executives who have been delegated the responsibility for safety, clearly suggests that he wants an effective safety performance—and it is a very dull employee indeed who does not respond accordingly.

Whatever managers communicate, directly or implicitly, is certain to have some marked effect on the work effort and the influence may be noted in performance differences in measurable areas. One demonstrable comparison is the relatively greater success of occupational safety programs, with respect to the nonoccupational.

In the U.S., off-the-job and on-the-job educational and promotional safety campaigns are similarly intense, but the off-the-job programs clearly are not work-oriented. Usually, they stem from local and national safety council activities and even though management contributes to the support of the councils, employees are not apt to feel that their chance taking while away from work is a concern to anyone but themselves. The risk takers, therefore, do not appear to be inclined to impose the same controls on their behavior that they do when at work.

At General Electric, for example, and throughout American industry, employees suffer far fewer accidental injuries at work than when off-the-job, where the employer's influence is not very effective. The fatal accident statistics indicate the noticeable difference in safety achievement off-the-job and at work: About 35 years ago (1930), 15 persons per 100,000 total population were killed at work. Last year, the rate was about one-half the 1930 experience (NSC 13). On the other hand, the motor vehicle accidental death rate over the same period has not improved equally and, in fact, seems to have stablized in the last 20 years.

Since people are at their jobs generally for much longer periods than they are on the road, it would seem that solely on the basis of time exposure, work fatalities could be expected to establish a higher rate than motor vehicle deaths. Also from the point of view of hazard potential, industry's jobs often are inherently often more dangerous than the automobile.

Therefore, if it is assumed that the on-the-job accidental death rate reduction was due largely to an increased popular safety interest, it could be expected that there would be a matching experience in the motor vehicle rate.

Accidental deaths in the home, to make another comparison, are about 1.5 times higher, on a 100,000 total population basis, than work fatalities. (Incidentally, these death rates are adjusted to the age distribution of the population in 1940. Accidental death rates differ widely between age groups. If the rates were not adjusted, they would be affected by changes in the average age of the population through the years.)

Safety specialists intuitively recognize the motivational effect of management's interest in safety and repeatedly assert that it is the basis upon which safety achievement is founded. In their efforts, they urge management to give more tangible expression to its desire for accident prevention. However, it is not often realized that at the employee level the mere fact that a safety activity is in place is a clear expression of managerial interest (except for instances where the activity is obviously de-emphasized by organizational and economic impositions).

Therefore, additional expressions of managerial interest alone are not likely to have a significant, if any, further influence. Amplification of the desired managerial effect is more certain when managers apply the same vigorous and positive administrative persuasiveness that underlies success in any business function.

There is good evidence that a close relationship exists between management effectiveness and safety performance. We find that when management operates its enterprise with taut controls, the measurable elements that contribute to business success may be noticeably improved.

At present, we are conducting an operations research study which indicates with acceptable significance that there is a strong relationship between management's ability to control all contingency loss areas and its success in reducing severe preventable work accidents.

It is not unusual to find safety achievement related to business effectiveness. In 1928, the American Engineering Council's Committee on Safety and Production conducted an extensive study of the association between safety and production efficiency. The conclusion was drawn generally that the safe plant is an efficient plant. This, however, is not entirely true.

It is possible, of course, to apply safety controls so rigidly that the factory's productive output is handicapped. Later studies (Grimaldi 57; Grimaldi 20) indicate that the phenomenon noticed in 1928 probably was a reflection of management's effectiveness in controlling manufacturing operations.

Management Controls Accident Rate

The more likely conclusion, therefore, is that outstanding safety performances occur where the plant management does its job well. A low accident rate, like efficient production, is an implicit consequence of managerial control.

A short while ago, two plants were surveyed under circumstances where safety was incidental to the audits. In the first, the layout of operations, the maintenance of a safe environment, the close supervision by foremen, the housekeeping in the shop and the general aura of good management were so outstanding that we could not help but inquire about the scope and depth of its safety program.

The president of the company informed us that no formal program was followed. It was a relatively small plant, with approximately 700 employees, and did not justify a safety specialist, he believed. He pointed out, however, that his works manager and each supervisor were held accountable to see to it that safety was taught as part of each employee's job.

1965

10,400,000 disabling injuries in 1965

The death total in 1965 was up about 2,000 over 1964. Motor vehicle and public deaths increased, while work and home fatalities decreased.

In this plant, the safe way to work was considered the correct way and was believed to be necessary in order to achieve a high productive and quality effort. We asked about the accident rates. For the past five years, the plant, engaged in heavy machining work, experienced a phenomenally low injury frequency rate for its industrial classification.

Immediately afterward, the second plant was surveyed. This was the opposite of the first in every way. The shop was a haphazard collection of workstations and the employees appeared to have little incentive for working. Managerial control seemed to be remarkably slack, and the opportunity for making a comparison of the two companies was taken.

They were both doing the same type of work, with the same number of employees, drawn from a comparable community, but the second company had a safety program: safety committees met; posters were hung; safety booklets were distributed; and all the conventional accident-prevention steps were attempted. However, the plant's past five year injury record was over five times poorer than the national averages for its industry.

Obviously, the organized safety effort was being damped by the overall managerial indifference to maximizing performance. We obtained the profit figures for each of the companies and were not surprised to find that in the preceding five years the first plant was as many as three times better in its net with respect to sales than the second plant.

The motivating influence of close supervision may be noted also in comparisons of the small, intermediate and larger manufacturing establishments. The small company, with less than 50 employees, often achieves a safety record which is comparable to that of the larger companies employing more than 500 workers. The higher disabling injury rates generally occur in the intermediate group.

The smaller plant's safety accomplishment often is achieved in spite of the absence of an organized safety program and may be explained by the probability that its management is in close contact with operations, gives personal attention to accidents and, therefore, communicates explicitly its interest in a generally effective work performance.

When the personnel exceed 50 in number, it generally becomes necessary to interpose a level of supervision over the production workers. This employer cannot afford to employ a safety specialist, he seldom belongs to any safety organization and his workers' compensation premiums seldom are large enough to warrant extensive service from his insurance carrier. Management's safety influence in the intermediate size plant is apt to be comparably weak, therefore.

As the subordinate managerial levels increase with company size, the persuasive influence of the executive office may be expected to diminish unless the managers are properly competent and constantly aware of their superior's aims for the business. Large companies customarily take greater pains to choose such capable senior and junior managers. Middle-size companies, however, are not always so competently staffed.

Difficulty in Motivating Employees

They are in the awkward position often of not being large enough to attract, train and retain professional managers and not small enough to enjoy the effects of close employer/employee understanding. Their generally poorer work injury experience, in the U.S. for example, probably reflects the consequent inherent difficulty of motivating employees effectively.

Maximum safety achievement can be expected where competent safety specialist effort is supplemented by strong managerial action. Today, throughout the U.S., outstanding safety records are being recorded in those plants where the safety program has been built around the manager.

The safety specialists, in these instances, and all levels of management, clearly understand their individual responsibilities and are held accountable for their accident prevention performance. Safety, therefore, becomes a positive factor in the production effort and literally is built into each job.

In those plants where "management's safety

Production time lost due to off-job accidents totalled 60 million man-days in 1965.

ALL DEATHS & INJURIES OF WORKERS

PLACE	DEATHS 1965	DEATHS 1964	INJURIES 1965	1965 RATES* Deaths	1965 RATES* Injuries
All Accidents	50,300	48,800	4,750,000	.12	11.7
At Work	**14,100**	**14,200**	**2,100,000**	**.10**	**15.1**
Away from Work	**36,200**	**34,600**	**2,650,000**	**.14**	**9.9**
Motor vehicle	22,600	21,500	800,000	.89	31.4
Public nonmotor vehicle	7,300	6,700	900,000	.08	9.4
Home	6,300	6,400	950,000	.04	6.5

*Per 1 million man-hours exposure.

National Safety Council *Accident Facts*, 1966 edition.

responsibility" is well understood, the manager is the focus of the plant safety program. He regards accident prevention as a field for rewarding human contact which keeps people free from injuries, stops losses and earns new profits. He opposes the traditional viewpoint that safety is a routine function with only a modest relationship to business effectiveness. He is aware that injuries are the result of costly failures to control the inherent risks in his business.

He relates the work of managing to the need for planning, organizing, coordinating and measuring his operation so that its output will increase without running the risk of preventable accidental loss. He must sense that a properly effective control effort embraces all aspects of his business' loss potential.

Burden of Accident Costs

It is doubtful that any businessman knows the burden accident costs impose on him. His accountants can obtain the total medical and compensation expense for the plant's work injuries, but this is not the complete sum.

Incidental costs such as interruption of the work flow, machine downtime, and possible product and equipment damage add to the total which usually are many times the direct workmen's compensation expense. A method has been suggested for computing the work injury direct and indirect costs, but there is no simple formula for estimating the overall expense for all the losses resulting from an inadequate risk control effort (Simonds and Grimaldi).

The profit-producing importance of effective methods for controlling accidental losses will increase in the future and the nature of the safety specialist's work will be affected. Now we are learning how to build complex, costly machines which will produce more with less effort. Even brief disruptions in their service may be very expensive and accidental interruptions to the components or personnel can be expected to be intolerably costly.

Although hazardous points of operation will be some distance from the production worker, it can be expected that the skilled maintenance experts will require a more sophisticated safety effort. The ratio of these technicians, with relation to the production force, will increase. Their greater number and the probability that they will encounter a varying hazard pattern will challenge the safety specialist's ingenuity if he is to assist effectively in the control of equipment and personnel accidents.

As industrial technology advances, therefore, the need for effective safety programs will increase. Although the plant probably will be somewhat safer, because machines are taking the labor out of work, accidents can be expected to be more costly. In addition to the likelihood that injury treatment costs and workmen's compensation benefits will follow wages as they rise, other direct costs resulting from procedural and performance errors will be greater.

As production and ancillary equipment becomes more complex, fewer but more skilled operators are required. The absence or errors of even one such employee can threaten a significant percentage of the plant's output. An effective accident control program, therefore, will be an increasingly important factor in maintaining the business' competitiveness.

Even now we can see comparatively greater safety improvement in the more technically advanced and competitive companies. The industries in the U.S. enjoying the best work injury rates generally are those whose plants and facilities are new and efficiently designed. All are industries in which the plant investment per worker is high and the labor and hazard content of jobs are reduced.

Machine Plays Prominent Role

In the U.S., among the 10 industries with the best safety experience, six—electrical equipment, aircraft manufacturing, automobile, rubber, steel and textile—are industries in which the machine plays a prominent role in the manufacturing procedures and processes.

On the other hand, among the 10 industries with the poorest safety experience, the six where comparable production machines are used relatively little are, for example, wholesale and retail trade, food, transit, air transport, construction and marine transportation.

As industrial research moves ahead, the safety specialist must keep pace. Technological advances will require that systems be planned and installed so that they will approach a faultless performance. This responsibility will be the design engineer's and he will be contributing, therefore, to the accident reduction effort in an ever-increasing way.

However, even though he is aware generally that his plans must consider human factor requirements, as well as the hardware, and although he is trained to build safety into his designs, he may not always satisfy safety's requirements fully. The engineer, by nature, is inclined to treat events which have a small probability of occurring as if they will not happen at all.

Thus, accident possibilities, if they seem remote, are apt to be discounted. While this point of view has practical merit, it also may be destructively disarming. It requires complete understanding of the project's inherent risks. Unless they have been determined by thorough analysis, it is likely that false conclusions will result and severe hazards will exist without provision for adequate control.

The cavalier attitude toward distant risks is not only an engineer's trait, of course. It is fundamental in all accident situations and is shared in some degree by most of us. It is this common tendency which we attempt to correct when we consider the need for motivation of safety and it should be clear from the foregoing that in the industrial setting only management's persuasiveness can provide the effective control.

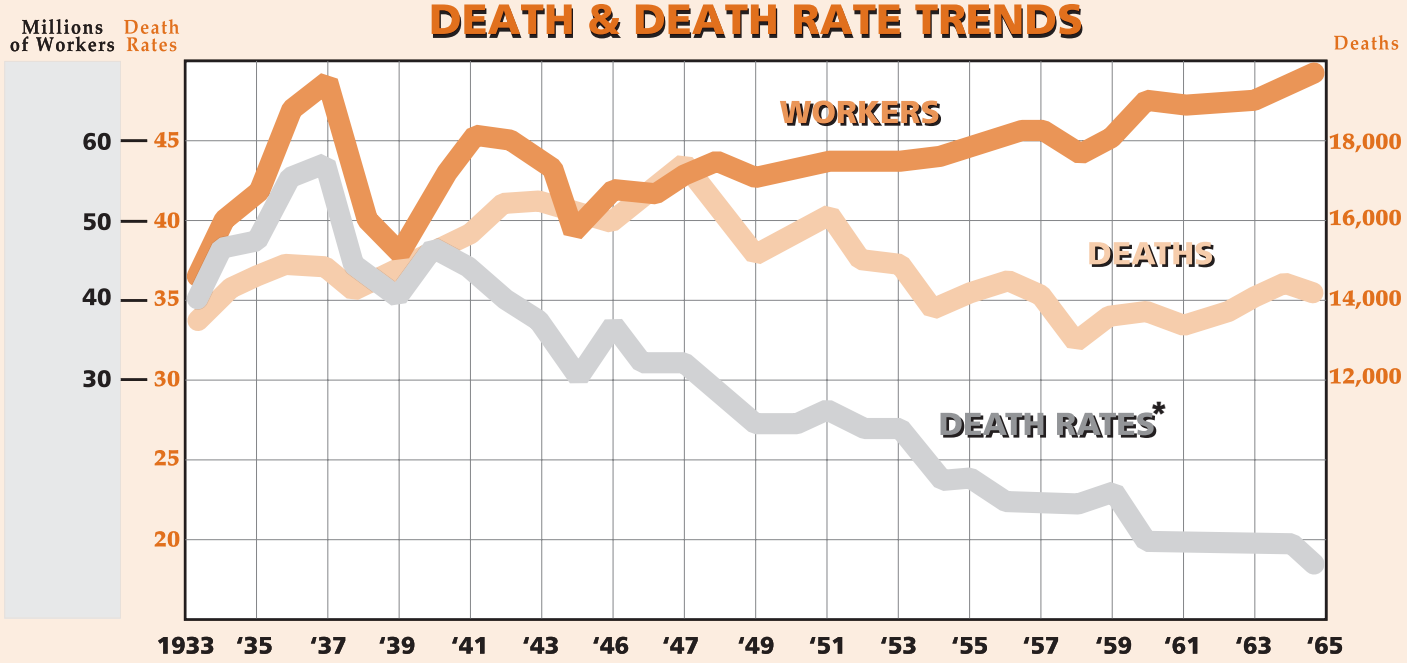
I suggest, therefore, that safety achievement cannot rely on such conventional approaches as employee training and plant inspections. The accident problem appears too complicated for such simple methods to solve. It is also too extensive to be dealt with casually.

The basis for effective control it seems is firmly fixed in the management decision-making process. The method essentially is a disciplined approach to risk evaluation and control. Its application is basically the same whether the concern at the moment is to eliminate employee injuries, safeguard the plant from destruction or make a profitable decision in the marketplace. I believe the steps to take are:

1965

A low accident rate, like efficient production, is an implicit consequence of managerial control.

Between 1912 and 1965, accidental work deaths per 100,000 population were reduced 67 percent.



*Deaths per 100,000 workers

National Safety Council *Accident Facts*, 1966 edition.

•Investigate the operation, process, project or system aggressively to identify each inherent risk to individuals and the enterprise.

•Evaluate each risk to determine those with no purpose or merit.

•Eliminate the purposeless risks.

•Ascertain that the tolerable risks are controlled to prevent accidents or severe consequences if an accident should occur.

•Correct any uncontrolled hazards.

•Follow up periodically to ensure that the controls are maintained and no new intolerable risks are introduced.

In these considerations, it may be evident that the role of the safety specialist will change in character. The customary inspection, safety promotion and training activities will be more or less subordinate to his loss prevention counseling of the plant's managers.

The degree to which the conventional approaches engage the specialist doubtless will be a function of his ability to analyze and marshal facts, his experience and the opportunity given him to provide such a contribution. His value to the safety effort will depend significantly on his ability to:

1) Develop loss control information which enables managers to make sound decisions, rather than endeavoring personally to convince employees to have a greater safety awareness.

2) Persuade management action rather than attempting to correct hazardous situations on his own.

3) Teach the methods for solving safety problems, rather than providing the answers.

I have tried to describe a practical approach and new philosophy for safety achievement. If I have been too didactic, please understand it is because I am enthusiastic over the opportunities for accomplishment that exist for the safety professional. They await each of us, with the promise of records that would satisfy anyone. ■

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